REMARKS

Claims 63-88 were pending in this application. Claims 63, 64, 68-70, 74, 75 and 79-81 have been rejected. Claims 65, 67, 71, 73, 76, 78, 82, and 84 have been objected to. Claims 89-90 have been added. Therefore, Claims 63-90 are pending in this application. Additionally, Applicant could not find where Claims 66, 72, 77, and 85-88 were addressed in the Office Action.

Reconsideration of the application based on the remaining claims as amended and arguments submitted below is respectfully requested.

Claim Rejections under 35 U.S.C. § 103

Claims 63, 64, 68-70, 74, 75 and 79-81 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Wiggs et al (5,671,608) in view of various combinations of Aoyagi (6,390,183), Suzuki et al (6,840,058), Brasz et al (6,892,522), and Schooley et al. (6,521,459).

R-410A Refrigerant in a Geothermal DX System is Not Taught or Suggested in the Cited Art

Initially, the Examiner rejects claims 63 and 74 as being unpatentable over Wiggs in view of Aoyagi, in that Wiggs discloses a DX heat pump, and Aoyagi teaches the use of R-410 refrigerant in a heat exchanger to enhance heat transfer coefficiency and to protect the ozone layer.

Factually, upon close examination, the Wiggs, et al, patent cited (US 5,671,608) discloses prior art utilizing an array of horizontally oriented, near surface, refrigerant transport heat exchange tubing (see column 3, lines 1 – 35, see column 6, lines 47 – 67, and column 7, lines 1 – 15), and discloses an improved array of subsurface tubing ratios and components (see column 7, lines 35 – 49, see column 9, lines 57 – 67, see column 10, lines 1 – 29, and see Claim 1 at column 11, lines 13 – 20).

All known prior DX related patent art, including the Wiggs patent cited, factually utilized R-22, or the like, refrigerant. While all known prior DX patent art utilized R-22 refrigerant, a similar refrigerant might be, for example, R-407C, or even ammonia, as each such chemical has operating pressures and phase change characteristics in the same approximate ranges as R-22, as is well understood by those skilled in the art. Factually, extensive testing by the Applicant has shown that the use of refrigerants, such as R-22 or the like, practically limited former DX system reverse cycle designs to operational depths of 100 feet or less, due to operational system pressures that were too low to overcome gravitational issues affecting condensed liquid refrigerant return in the cooling mode. This is why the Applicant found, via extensive field testing, and as described in the subject patent application, that the utilization of an R-410A refrigerant, which has greater working pressures than R-22, is better suited for operation with direct expansion ("DX") systems, and especially is better suited for a deep well DX system designed

for operation at depths between 100 and 300 feet (see Applicant's original patent application at paragraphs number 14, 17, 25, 87, and 88), where the use of an R-22, or the like, refrigerant would be impractical.

Applicant's testing has shown that R-410A operates at pressures about 30 % to 40% greater than R-22 in a DX system application. First, this facilitates and enhances the operational performance of all predecessor DX systems, in that testing in conventional, near surface, DX system designs has shown its higher operational pressures facilitates liquid line refrigerant return in the cooling mode from any sub-surface heat exchange array, which has always been an issue of concern in DX system applications. Second, the use of R-410A, instead of an R-22, or the like, refrigerant in a deep well DX system application (over 100 feet deep), makes reverse-cycle system operation possible absent the use of any auxiliary and power consuming supplemental refrigerant pump to pull the refrigerant out of the deep well when operating in the cooling mode, thereby materially enhancing performance Coefficient of Performances ("COPs").

By way of additional explanation, as is well known by those skilled in the art, that R-410A is not a similar refrigerant to R-22, or the like. As R-410A is a blended refrigerant, which, operating at materially greater pressures than R-22, or the like, requires stronger compressors and other containment components with increased safety margin burst strengths. Thus, R-410A is neither a drop in, nor an obvious, replacement for R-22, and was only determined to be well suited for use in a deep

well (beyond 100 feet deep) DX system application by Applicant after extensive testing.

Aoyagi Teaches Away from and is Inoperable with a Geothermal DX system

The mere fact that Aoyagi teaches the use of R-410A in a heat exchanger because of alleged heat transfer coefficient enhancement and because it protects the ozone layer has absolutely no hint of why one should utilize R-410A in a DX system, deep well or otherwise. Aoyagi's design is for enhanced efficiencies in conventional refrigerant to air heat exchangers, which transfer heat via convection, not via conduction as in the sub-surface heat exchanger of a DX system design.

Aoyagi teaches the utilization of sealed tubing inserted into the interior portion of refrigerant transport tubing used for convective heat transfer purposes. See US 6,390,183 B2, at column 3, lines 26 – 48.

The fact that Aoyagi simply cites the potential use of R-410A or R-290 (propane), as a refrigerant with a higher density than R-22 at the same cycle point, which would allegedly provide an advantage in his subject sealed tube within a tube (for convective heat transfer purposes) design, and that there is an ozone depletion potential advantage (see column 5, lines 62 – 67, and column 6, lines 1-10,) has absolutely no bearing or obvious relation to the use of R-410A in a DX system as described by Applicant. The Examiner is respectively requested to note that Aoyagi

neither teaches nor discloses any information regarding the operational pressure differences between R-22 and R-410A, nor why the use of a refrigerant with greater operational pressures than R-22 would be an advantage in any system, much less in a DX system utilizing conductive heat transfer in a sub-surface application.

Further, Aoyagi makes no claims regarding the use of R-410A. Aoyagi's Claims, regarding refrigerants, solely pertain to HFC or HC refrigerants for use in his described and claimed designs utilizing sealed tubes within a tube for convective heat transfer purposes. Such a refrigerant would be R-407C, which has no chlorofluorocarbon, and which has no ozone depletion potential, but which does have drop in and similar operational characteristics and operating pressures similar to R-22, and which, therefore would be totally unsuitable for use in a deep well DX system application.

The mere fact that a refrigerant is mentioned in any patent pertaining to heat exchange, and especially in a patent application pertaining to convective air (not conductive sub-surface) heat exchange, does not make such refrigerant an obvious choice for use in a DX and/or in a deep well DX system application for the reasons explained.

Applicant does not understand the reason for the Examiner's rejection of Claims 68 and 79 via the explanation that "Claims 68 and 79 are rejected under 35 USC 103(a) as being unpatentable between 50 psi and 180 psi could be provided in order to run a direct expansion heat pump system." If the Examiner means it would

be obvious that the operational pressures required to operate a DX system would be between 50 psi and 180 psi for use with conventional R-22, or the like, refrigerant, that could be partially correct (pressures can actually go as high as 250 psi). However, absent extensive testing by Applicant, which evidenced the advantages of utilizing an R-410A refrigerant in a DX system application, and particularly in a deep well DX system application, it would not be obvious to anyone that the use of an R-410A refrigerant would require DX system operational pressures between 80 psi and 405 psi.

Suzuki Does Not Teach a Polyolester Lubricant for a DX system

The Examiner rejects Claims 64 and 75 based upon the above-said and above-argued rational of Wiggs, and Aoyagi, which, for the above-described reasons, are not valid reasons for rejection. However, the Examiner further cites Suzuki, at US 6,840,058, as a reason for rejecting the use of a polyolester lubricating oil in conjunction with an R-410A refrigerant in a DX system application, using conductive (not convective) heat transfer.

The Examiner is correct in that Suzuke teaches the use of polyolester as a lubricating oil for use in conjunction with his unique carbonic acid trapping filter in a carbon dioxide refrigerant system (the primary thrust of Suzuke's invention). However, Suzuke makes zero mention of the use of a carbon dioxide refrigerant in a DX system application, and any such use would be far from obvious, as conventional

DX system designs have all used R-22, or the like, refrigerants, with all such like refrigerants having operating pressures similar to R-22, which, as aforesaid, are all materially lower than the R-410A operational pressures that testing has confirmed are better suited for use in DX system designs and/or in deep well DX system designs. Suzuke does not disclose what the operating pressure of a carbon dioxide refrigerant system is, either in a conventional convective heat transfer system, or in a conductive heat transfer DX system application. The thrust of Suzuke' invention is the use of an appropriate filter for a system using carbon dioxide as a refrigerant, because carbon dioxide has no ozone depletion potential an a unique carbonic acid trapping filter would be advantageous when carbon dioxide is used as a refrigerant.

Suzuke makes zero mention of what lubricating oil would be best suited for a system where carbonic acid was not a concern. It is well known by those skilled in the art that carbonic acid will never be produced via utilization of an R-410A refrigerant. Thus, the use of any particular lubricating oil in a carbon dioxide refrigerant system, whether or not polyolester, would never even hint or suggest what an appropriate lubricating oil might be for use in an R-410A DX system application. R-410A is a totally and completely different chemical than carbon dioxide.

Factually, the Applicant's subject application never mentions the use of carbon dioxide as a refrigerant, which carbon dioxide refrigerant, as stated, has material differences from the preferred and described R-410A chemical claimed for

use by Applicant in a DX system application. While it is well known that a Suniso 3 GS, or the like, lubricating oil is preferred for use in a conventional or in a DX system operating on R-22, Suzuke's teaching the use of a polyolester lubricating oil for use in conjunction with a carbon dioxide refrigerant system has absolutely no bearing on the preferred lubricating oil for use with R-410A in a DX system application, as taught and claimed by Applicant herein.

Brasz Does Not Teach R-410A refrigerant and is operable a DX system

The Examiner rejects Claims 69 and 80 in view of Braz (US 6,892,522), Aoyagi, and Wiggs. The rationales as to why the cited Aoyagi and Wiggs patents would not be obvious in the subject application have already been explained above. Regarding Braz, the Applicant respectfully submits that, upon close examination, Braz teaches a more efficient electrical, or other, generating means via using a gas turbine engine to power a generator. Braz teaches to provide the gas turbine with cooled inlet air (to increase operation efficiencies implied) by means of a motor driven compressor, which compressor is powered via electricity produced from the primary turbine engine/generator.

No mention of R-410A is made anywhere in Braz. No mention of any DX system application is made anywhere in Braz. The discussion of refrigerants and pressures in Braz pertain to explaining that a conventional centrifugal compressor using R-134A (which R-134A refrigerant has no ozone depletion potential and can

sometimes be used as a good drop replacement for an R-22 refrigerant), with typical operational pressure ranges between 50 and 180 psi (not between 80 and 405 psi as claimed by the Applicant for use with an R410A refrigerant in geothermal DX system application), cannot be used in Braz's turbine application because the pressures would excessively rise to 500 psi. In fact, Braz explains that if R-134A were to be utilized in his subject turbine application, the operational pressures would be so high that it would not be practical, and, therefore, Braz teaches the use of an R-245fa refrigerant that has 40 to 180 psi operational range. See column 6, lines 8 – 29. Braz's teachings regarding the primary use of a turbine application and the use of R-245fa, in lieu of R-134A, have no realistic or obvious relationship to the Applicant's teachings pertaining to the use of an R-410A refrigerant in a DX system application.

Additionally, the Examiner rejects Applicant's claims 70 and 81 in view of the aforesaid Wiggs, Braz, and Suzuki patents. Applicant has above explained why rejections based upon the aforesaid Wiggs, Braz, and Suzuki patents should not be sustained.

Applicant's System Operates on R-410A Refrigerant Not Carbon Dioxide and the Prior Art Lack Motivation for R-410A Use in DX Systems

The Examiner further states at page 4 of the subject Office Action that "Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the direct expansion geothermal heat pump of Wiggs, et al, in view of Braz et al, and in view of Suzuki, et al, such that polyolester oil could be provided in order to run a direct expansion heat pump system with carbon dioxide refrigerant." The Applicant respectfully points out to the Examiner that the Applicant's invention is designed to operate on R-410A refrigerant, not on carbon dioxide refrigerant. Those skilled in the art clearly understand that a carbon dioxide refrigerant has materially differing properties and applications from an R-410A refrigerant chemical (which is a refrigerant blend).

The Examiner's second "Response to Arguments" on page 5 of the subject Office Action pertains to reasons as to why the alleged Applicant's arguments that "the carbon dioxide refrigerant is used in his invention only for gravitational problem in deep wells not for the reason of enhancing heat transfer and ozone layer protection reasons."

In response to this Response to Arguments from the Examiner, the Applicant respectfully points out to the Examiner that the Applicant's invention is designed to operate on R-410A refrigerant, not on carbon dioxide refrigerant, which has materially different characteristics and properties.

Further, the previously cited Aoyagi invention primarily allegedly enhanced heat transfer by reason of placing a sealed tube within a refrigerant transport heat exchange tube so as to reduce the refrigerant flow passage as the mass flow rate quality is increased; so as to reduce the thickness of the liquid film of an inner surface of a tube by adhering the condensed liquid to an outer surface of an inserted member; and so as to reduce the amount of refrigerant to be charged by reducing the volume in the heat exchange tube. See Aoyagi column 3, lines 26 – 48. The only reason R-410A was mentioned by Aoyagi, along with R-290, was because the refrigerants allegedly had higher refrigerant density (higher operating pressure was never mentioned) at the same cycle point than R-22, and thus allegedly had lower current speed, with alleged ability to lower pressure loss to about 70%, and therefore allegedly provided greater heat transfer coefficients with Aoyagi's particular design of a sealed tube within a tube in a convective heat exchange system. Additionally, Aoyagi recommends the use of a non-ozone depleting chemical for use in conjunction with his sealed tube in tube invention for convective heat transfer. See column 5, lines 62 – 67, and column 6, lines 1 – 10.

The Applicant's subject invention does not utilize a sealed tube within a tube. The use of R-410A is not taught in the Applicant's design for either higher refrigerant density, for lower current speed, or for the pressure loss to be lowered to about 70%. In fact, in the Applicant's subject invention, the DX system's operational efficiencies in the sub-surface geothermal heat exchange medium would be impaired

by lowering the current speed, by and by lowering the pressure loss to about 70%. Thus, Aoyagi's invention would never even be remotely considered for utilization in the Applicant's sub-surface conductive heat exchanger. The Applicant's use of R-410A is not for convective heat transfer applications, is not to lower refrigerant current speed, and is certainly not to lower the pressure loss, all of which would be counter-productive. Thus, via a careful reading of the alleged advantages of using an R-410A, or an R-290, refrigerant by Aoyagi, one would have reason to totally avoid the functional use of an R-410A refrigerant in a DX system application design such as that disclosed by Applicant.

However, when a sealed tube placed within a refrigerant transport heat exchange tube is not utilized in a convective heat transfer system, as taught by Aoyagi, fortunately, as testing by Applicant has disclosed, the use of R-410A refrigerant does not lower refrigerant current speed, and does not lower pressure loss, all of which are advantageous in Applicant's design.

Additional Comments and Responses to the Rejections and Office Action Remarks

Factually, the results of utilizing an R-410A refrigerant with increased operational pressures between 80 and 405 psi in a DX system application were not known until Applicant field tested same. The results enabled Applicant to eliminate the need for a power consuming refrigerant pump to pull refrigerant out of the

ground in the cooling mode when operating at depths beyond 100 feet, and evidenced enhanced operational performances in conventional near-surface DX system designs. None of these field tested results could possibly have been known via disclosures of the art cited by the Examiner. As mentioned, a close examination of Aoyagi would tend to frighten one away from even trying R-410A in a sub-surface DX system application. Fortunately, when one does not use the convective heat transfer alleged advantages taught by Aoyagi, with a closed ended tube within a tube, testing by the Applicant has proven that the otherwise adverse results to a DX system's sub-surface heat exchange refrigerant performance, via the use of an R-410A refrigerant, are not encountered. To the contrary, as explained, refrigerant flow is not slowed, and pressure losses are not reduced. The increased operational pressure design ranges (between 80 and 405 psi) in a DX system design actually permits one to obtain liquid refrigerant return from a deep well (in excess of 100 feet deep), absent the necessity of a refrigerant pump to pull out the liquid refrigerant, and actually increases operational efficiencies in other near-surface DX system designs.

The Examiner argues that the use of carbon dioxide is cost effective because of enhanced heat transfer coefficient (based upon a misapplication of Aoyagi, who alleges an enhanced heat transfer coefficient because of lower current speed and an ability to lower pressure loss to about 705, as previously explained). As explained, such results touted by Aoyagi would actually all be very negative in a DX system

application, which optimum DX system design would be based upon conductive (not convective) heat transfer, where the sub-surface current speed must be maintained (not reduced) and where pressure losses must be avoided (not lowered). Thus, even if the Examiner substituted R-410A for carbon dioxide in his argument, the Examiner's argument basis would be incorrect. Factually, the ability to get the liquid refrigerant out of the ground in a DX system in the cooling mode, and particularly in a deep well application (in excess of 100 feet deep), absent the necessity of a power consuming refrigerant pump, is of paramount concern.

Whether or not R-410A had any enhanced heat exchange coefficient over R-22 is immaterial when compared against the ability to efficiently get the liquid refrigerant out of the ground at all in the cooling mode. Even if R-410A had less of a heat exchange coefficient than R-22, but it could be returned from the ground because of its unique operational pressures in a DX system application, absent the necessity of operating a supplemental refrigerant pump, it would still be preferred, as the lack of heat exchange coefficient could be made up via simply installing extra heat exchange tubing lengths. Thus, the Examiner's belief and argument that the prime reason for using a high pressure refrigerant in a DX system application is primarily because of enhanced heat transfer coefficient is incorrect. If one is not able to get the liquid refrigerant out of the ground in the cooling mode when the ground is the condenser, the system will not work, and the heat transfer coefficient of the refrigerant utilized, whatever the refrigerant may be, is then totally

immaterial. The refrigerant with the best heat transfer coefficient in the universe will be of absolutely no value in a DX system if the system is not operational.

Lastly, the Examiner argues that there is no difference between Applicant's DX system and the regular split type refrigeration system having a compressor, condense, evaporator, and expansion valve, and the Examiner references US 6,722,141 to Ferris; US 5,214,932 to Abdelmalek; and US 6,427,454 to West. The Examiner is only partially correct. While several of these patents cited by the Examiner refer at various points to a "direct expansion system," the Examiner fails to realize there are two distinct and separate definitions for the loosely used term "direct expansion" as utilized in the industry, as is well understood by those skilled in the art.

A commonly understood short term for a "direct expansion refrigeration cycle" is a "direct expansion system". However a "direct expansion refrigeration cycle" actually means a system where a cool refrigerant vapor at a low pressure goes through a vapor compressor and exits as a high, hot, pressure vapor; the high pressure and hot vapor then goes through a condenser that removes the high level heat and condenses the vapor into a warm liquid, the now warm liquid goes through an expansion device that reduces the pressure and temperature of the refrigerant; the refrigerant fluid then goes through an evaporator where it absorbs heat and changes phase back into a cool, low pressure vapor, where the process is repeated. The above "direct expansion refrigeration cycle" is basically the same for any

refrigeration system in the world, with multiple variations, including a geothermal system.

However, in the geothermal heating/cooling industry, as is well understood by those skilled in the art, the term "direct expansion system" refers to a geothermal system that "directly' exchangers heat between the refrigerant and the ground in its sub-surface heat exchanger, as opposed to exchanging naturally occurring and renewable heat through an intermediary water loop, which is commonly referred to as a water-source geothermal system. The difference between these two system designs, in the geothermal field, is explained by Applicant in the Background of the Invention segment at paragraphs number 6 through 15.

Since the natural geothermal heat is directly exchanged with the ground, where the condensed, cold refrigerant is directly expanded into a cool vapor by the natural heat in the ground in the cooling mode, such a type of geothermal heating/cooling system is also commonly referred to as a "direct expansion", or as a "DX" system by the geothermal heating/cooling industry and art. Sometimes, a geothermal "DX' system is also referred to as a "direct exchange" ("DX") system because it exchanges heat directly with the ground, without having to go through an intermediary water loop.

With the above in mind, and because the Applicant's system has clearly been identified as a geothermal DX system in Applicant's "Background of Invention" segment, the Examiner's finding that there is no difference between the definition of

Applicant's DX system and those of other common designs, as cited in the referenced Ferris, Abdelmalek, and West patents, is incorrect.

Ferris teaches how to place an additional fluid, such as oil, stop-leak liquid, acid neutralizer, drying agents, and ultra violet colored leak finder fluids into a refrigeration system. See column 1, lines 15 – 22. The Ferris invention could, by no possible stretch of the imagination, be equated to the Applicant's subject designs.

Allowable Subject Matter

The Examiner specifically stated that Claims 65, 67, 71, 73, 76, 78, 82 and 84 were objected to but would be allowable if rewritten to include all of the features of the base claim and any intervening claims. These claims depend for allowable independent claims and should be allowable there from.

Applicant was unable to find any rejections or objections in the Office Action for Claims 66, 72, 77, and 85-88 and assumes that these claims were allowed,, thank you.

Applicant has added Claims 89 and 90.

Applicant has commented on some of the distinctions between the cited references and the claims to facilitate a better understanding of the present invention. This discussion is not exhaustive of the facets of the invention, and Applicant hereby reserves the right to present additional distinctions as

appropriate. Furthermore, while these remarks may employ shortened, more specific, or variant descriptions of some of the claim language, Applicant respectfully notes that these remarks are not to be used to create implied limitations in the claims and only the actual wording of the claims should be considered against these references.

The Commissioner is authorized to charge any deficiency or credit any overpayment associated with the filing of this Supplemental Response to Deposit Account 23-0035.

Respectfully submitted,

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